TITLE: CONTROL SYSTEM FOR HYDROSTATIC PUMP

BACKGROUND OF THE INVENTION

This invention relates to a control system for a hydrostatic unit. More specifically, and without limitation, this invention relates to a control system that utilizes a dither signal incorporated with its normal input signal in order to adjust the angle of a swashplate.

In the art of hydraulics, oil is pumped by mechanical hydraulic pumps for the purpose of causing a hydraulic motor to revolve, a hydraulic cylinder extend, or for other useful purposes. A common aspect of many tractors, earthmoving machines, and the like is a hydrostatic transmission. In its most basic form a hydrostatic transmission consists of a hydrostatic pump which is normally driven by an internal combustion engine, and provides a source of pressurized oil flow which causes one or more hydrostatic motors to rotate. The rotation of these one or more hydrostatic motors will cause the machine to travel forward or reverse as commanded by the drive of the machine.

The swashplate is a mechanism in a hydrostatic transmission that controls the fluid flow that a hydraulic pump may deliver. Usually the angle of the swashplate is determined by a hydraulic cylinder or servo system based on information that a control system or microprocessor receives. A typical microprocessor uses an algorithm to determine an output signal that will adjust the swashplate to a position. The pump and servo system usually do not match the resolution and accuracy of the input signal to the hydrostatic unit. This can cause the incorrect positioning of the swashplate.

Thus, it is a primary object of the present invention to provide a control system for a hydrostatic pump that improves upon the state of the art.

Another object of the present invention is to use a dither signal to improve the resolution and accuracy of fluid flow (e.g. swash angle position) of the pump and/or motor in a hydrostatic control system.

Yet another object of the present invention is to provide a hydrostatic control system that is able to adjust a swashplate angle based on system parameters using a dithered signal.

These and other objects, features, or advantages of the present invention will become apparent from the specification and claims.

BRIEF SUMMARY OF THE INVENTION

The present invention is a control system that controls the angle of a swashplate. The control system can be a microprocessor that receives information from a feedback sensor and setpoint sensor. The microprocessor determines not only the angle of the swashplate but also a set point command. From the information received from the sensor(s), the microprocessor uses an algorithm to process the information and send out an output command signal. The microprocessor can simultaneously send out a superimposed dither signal that produces a resulting signal that drives a pressure control. The pressure control in turn causes a servo system to alter the angle of the swashplate.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view of the hydrostatic pump of this system;

Fig. 2 is a block representation of the control system of the present invention;

Fig. 3 is an enlarged scale portion 3-3 of Fig. 1;

Fig. 4. is an enlarged scale portion 4-4 of Fig. 1; and

Fig. 5 is an enlarged scale portion 5-5 of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

The control system of the present invention can be connected to the hydrostatic pump seen in Fig. 1. The hydrostatic pump 10 has a central housing 12 of a standard servo hydrostatic pump. A servo piston 14 is disposed through the central housing 12. The servo piston 14 incorporates a servo screw 16, spring guide 18, servo spring 20, and spring seat 22.

The hydrostatic pump 10 also has a swashplate 24. Swashplate 24 is connected to a shaft feedback assembly 26 that works with the angle sensor assembly 28 to determine the angle of the swashplate 24. The swashplate 24 connects to the central housing 12 by use of a cone bearing 30 that is connected to cup bearing 32 which is then connected to a first O-ring 34. The first O-ring 34 rests against the bottom of plate adapter 36. A second O-ring 38 meshes between the plate adapter 36 and the bottom of the central housing 12. On the top of the housing is a bi-directional pressure control PCP assembly 39 having two coils. As one can appreciate from Fig. 1 this is a standard servo hydrostatic pump.

Fig. 2 shows in block form a typical closed loop control system can used to drive hydrostatic pump 10. The

control system includes feedback sensor 40 and an operational parameter setpoint sensor 42. The setpoint sensor 42 sends a setpoint signal 44 and the feedback sensor 40 detects the angle of the swashplate 24 and sends a feedback signal 46. Both the setpoint signal 44 and the feedback signal 46 are received by a device having the capability to produce a dithered electrical control signal. This device in a preferred embodiment is a microprocessor 48 as pictured; however, in alternative embodiments the device may be an electric joystick, an electric foot pedal control, or any other device that can produce a dithered output signal. The microprocessor 48 then sends out a control signal 50 comprised of an average signal and a dither signal. A pressure control 52 then receives the control signal 50 and creates a pressure signal 54 or 56 that is sent to a servo system 58. The servo system 58 then produces a force 60 that alters the position of swashplate 24. It should be appreciated that the feedback sensor 40 is optional as the system can improve performance in a closed loop as well as open loop mode.

In the microprocessor 48 an error signal is generated which is processed through a typical closed loop algorithm. These algorithms include, but are not limited to, PID, PID plus feed forward, and KIDT1. From the output of the algorithm(s) the microprocessor 48 creates an output signal that is superimposed with a dither signal generating the resulting signal 50 that is received by pressure control 52. It should be appreciated that the pressure control 52 can be of any type, including but not limited to a flapper nozzle style pilot valve with two boost spools, a flapper nozzle style pilot valve with one boost spool, a flow control (a device that converts an electrical signal into an hydraulic

signal to position the swashplate), or a plurality of pressure controls.

The pressure control 52 responds to the output signal and the dither to generate a dithering servo pressure. Based on this dithering servo pressure the max slew rate of the swashplate 24 is determined. The pump swashplate 24 position is therefore determined by the typical force balance of the servo springs, servo pressure, pressure moments, speed moments, and other system factors.

It should be appreciated that the dither signal created by the microprocessor 48 can be independent or dependent of the swash angle value related by feedback sensor 40. Furthermore, the feedback sensor 40 and the closed loop algorithm used by the microprocessor can be any standard feedback sensor or algorithm. In the current embodiment the microprocessor 48 generates the dither signal; however, the dither signal could also be generated internally in the pressure control 52 or externally in another device.

It will be appreciated by those skilled in the art that other various modifications could be made to the device without the parting from the spirit in scope of this invention. All such modifications and changes fall within the scope of the claims and are intended to be covered thereby.